# SPECIFICATION
# FOR
# UNINTERRUPTABLE POWER SUPPLY (UPS)
# WITH ACDB

**PROJECT:** ***65MWp SOLAR PV POWER PLANT***

**CUSTOMER:** ***M/s NEVELI LIGNITE CORPORATION LTD,***
***NEYVELLI, TAMILNADU***

Ref. Doc

# PURCHASE SPECIFICATION FOR UNINTERRUPTABLE POWER SUPPLY (UPS) - 230V A.C

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## 1. INTRODUCTION

Bharat Heavy Electricals Limited (BHEL), Project Engineering & systems Division, Hyderabad is setting up 65 MWp Grid-connected Solar PV Power Plant at Neyvelli, Tamilnadu for NLC. This document provides technical specification for UPS that caters to the 230V auxiliary AC power supply requirements of power plant.

The power plant has ten PEB (pre-engineered building) Power Collection Sub Station(PCSS) and two Power Export Sub Station (PESS). Whereas each PEB Power Collection Sub Station(PCSS) employs a 5KVA ups ( for 230V auxiliary AC UPS requirement) with standby Valve Regulated Lead Acid (VRLA) type battery bank of 4-hour back up time, Power Export Sub Station (PESS) has a 10KVA( for 230V auxiliary AC UPS loads requirement) with Valve Regulated Leas Acid (VRLA) type battery bank of 4-hour back up time.

## 2. SCOPE OF SUPPLY & SERVICES

Bidder's scope of supply & services shall consist of the following:-

a) Design, Manufacture, Assembly, Testing, supply & transportation of UPS system & mandatory spares to site.
b) Supply of startup & commissioning spares required for successful commissioning including supply of any other spares as required during commissioning at free of cost.
c) Supervision of erection and assembly
d) Complete testing & commissioning at site.
e) Touch up painting at site.

| Sl. No | Item Description | Qty |
|---|---|---|
| 1.1 | Supply of 5KVA UPS(1x100% rectifier,1X100% inverter & servo bypass) along with ACDB & 1x100% VRLA type battery (4-hours back-up ) for PCSS room as per scheme | 11 Sets |
| 1.2 | Supply of 10 KVA UPS (2x100% rectifier, 2X100% inverter & servo bypass) along with ACDB & 2x100% VRLA type battery (4-hours back-up) for PESS room as per scheme. | 2 Sets |
| 1.3 | Supervision support for installation and commissioning of UPS for PEB PCSS at project site. **Note:** 1 Set stands for eleven no. of 5KVA UPS System package. Lump sum amount shall be offered per 1 Set basis. | 1 Set |
| 1.4 | Supervision support for installation and commissioning of UPS panel for PESS room at project site. **Note:** 1 Set stands for two no. of 10KVA UPS System package. Lump sum shall be offered per 1Set basis. | 1 Set |
| 1.5 | Mandatory spares as per part-3 of Annexure-A to specification | |

## 3. STANDARDS

a) The equipment covered by this specification shall be in line with the requirement of IEC 801-805, EN 55022. Class-B, EN 50091-1 and the latest editions of the following IS/IEEE/IEC

standards, unless otherwise specified. The latest edition shall be prior to the date of purchaser's enquiry:

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|---|---|
| IEC 529 / IS 2147 | Dust proof and weather proof enclosure |
| IS 5 | Colors for ready mixed paints enamels |
| IS 1248 | Direct acting indicating analogue electrical measuring instrument and their accessories. |
| IS 3136 | Polycrystalline semiconductor rectifier equipment |
| IS 3700 | Essential Ratings and Characteristics of Semiconductor Devices |
| IS 3895 | Monocrystalline semiconductor rectifier cells and stacks |
| IS 5001 | Guide for Preparation of Drawings of Semiconductor Devices |
| IS 8623 (Part-II) 1993 | Type tests for switch gear |
| IS 8828 : 1996 /IEC 898 | Electrical Accessories - Circuit Breakers for Over Current Protection for Household and Similar Installations |
| IEC 60146-1-1 | Insulation testing for UPS |
| IS 10918 | Vented Type Nickel Cadmium Batteries |
| IS1652 | Lead Acid Plante Batteries |
| IS 1651 | Lead Acid Tubular Batteries |
| IEEE 1106 | Recommended practice for maintenance, testing & replacement of Ni-Cd storage batteries for generating stations & substations. |
| IEEE 1115 | Standard for sizing criteria & other technical features |
| IS 5469 (Part 1 to 3) | Code of practice for the use of semi-conductor junction devices |
| IS 6619 | Safety code for semiconductor rectifier equipment. |
| IS 7204 (Part 1 to 4) | Stabilized power supplies dc output. |
| IS 4540 | Mono crystalline semiconductor rectifier assemblies and equipment. |
| IS 6297 | Specification for Transformers & inductors (power, audio, pulse, switching) for electronic equipment. |
| IEC 60146 | Semiconductor converters. |
| IEC 61000-4-2,3&5 | Electromagnetic compatibility (EMC) |
| IS 13314 | Solid State Inverters run from storage batteries |
| IEC 62040 | Uninterruptible power systems. |
| IS 13947 (Part 1, 3, 4 & 5) | Low voltage switchgear and control gear. |

b) Wherever Indian standards are not available, the standards issued by IEC/BS/VDE/IEEE/NEMA or equivalent agency shall be applicable.

c) In case of imported equipment, standards of the country of origin shall be applicable provided those standards are equivalent or more stringent than the applicable Indian standards.

d) The equipment shall also confirm to the provisions of Indian Electricity Rules and other statutory regulations currently in force in the country.

**4. GENERAL REQUIREMENTS**

a) Bidders are advised to contact BHEL for essential technical queries in writing within one week of issue of Enquiry. Offers with incomplete information will not be considered for evaluation, and are likely to be rejected outright without any further interaction with the Bidder.

b) Unsolicited requests from bidders for alterations to their already submitted offer will not be entertained. These would not be taken cognizance, and offers will be evaluated without taking into account such requests/correspondence.

c) Any technical features [over & above BHEL enquiry specification requirements] proposed by Bidder will not be given preference for the purpose of evaluation.

**d) Bidders are advised to comply to specifications in total, unless the requirement is not feasible. In case feasible deviations are proposed by the bidder and subsequently withdrawn, no commercial implications can be claimed by the bidder.**

e) In the event of any conflict between these specifications, data sheets, related standards, codes etc. the Bidder shall refer the matter to the BHEL for clarifications and only after obtaining the same shall proceed with the manufacture of the items in question.

f) Each equipment shall have a 316 SS nameplate attached firmly to it & at a visible place with the following information:

i. Equipment Power rating, Voltage rating, model number.
ii. Manufacturer's name, emblem.
iii. BHEL P.O. No
iv. BHEL Dispatch no

g) Bidder must submit offer in two-parts (Technical Bid & Price Bid).

h) Documents to be submitted as a part of the technical bid have been cited at Cl 8 of this document.

i) **The Price bid must be submitted in the Price Schedule format indicated in Part 6 of Annexure A (Project Specific Data) to this specification**.

## 5. TECHNICAL REQUIREMENTS:

UPS Common technical requirements are listed out here. Part 4 of Annexure A to this specification has to be referred for the project specific purchaser's data. In case of contradiction between these two documents, the details in Annexure A will prevail.

| S.No | Description | : | Technical Requirements |
|---|---|---|---|
| a) | UPS System Package Items | | UPS consists of Static rectifier, battery, static inverter, and static & manual by pass switches, bypass line transformers, Servo Voltage stabilizer, isolation transformers, other Isolating and protection devices and all other equipment/accessories required for completeness and satisfactory performance of the UPS system. |
| b) | Type of UPS | : | (i) Single phase, **Stand alone** as per Drg/SLD indicated at Cl 12.1 below for 5KVA UPS.<br>(ii) Single phase, **Stand alone** as per Drg/SLD indicated at Cl 12.2 below for 10KVA UPS.<br>(iii) Relative Harmonics: Less than 5% for linear and non-linear loads. |

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| | | | (iv)If UPS KVA rating is applicable at a lower ambient temperature than specified 50 deg.c, the bidder shall consider a derating factor of at least 1.5%/deg.c for arriving at the specified UPS capacity at 50 deg.c ambient. |
| c) | UPS Incoming feeder details | : | (i) 2 No's of 3-phase incoming feeders from purchaser's Normal AC supply for main UPS. |
| d) | UPS Rectifier / Charger for 5KVA/10KVA UPS | | (i) Function: To supply DC Power to Inverter as well as battery.<br>(ii) Type: Solid-state, 3-phase, full wave, fully controlled, Float cum Boost Type<br>(iii) Duty: Continuous<br>(iv) Provision for online automatic as well manual charging facility.<br>(v) Protected against reverse battery connection.<br>(vi) Automatic Voltage regulation<br>(vii) Input filter circuit if required<br>(viii) Soft start feature to gradually accept load on initial energizing.<br>(ix) Sizing calculation:<br>Charger rating= **Inverter input current + Battery Boost charging current**<br>Where<br>→Inverter input current= $\frac{\text{Inverter rated KVA x 1000 x Load P.F.}}{\text{Inverter efficiency x no. of cells x Float Cell voltage}}$<br>→Battery Boost charging current= 0.2 x Battery AH rating for VRLA Battery |
| e) | Inverter | : | (i) The static inverter shall be of continuous duty, solid state type using proven Pulse Width Modulation (PWM)/Quasi square wave/step wave technique. Ferro-resonant types Inverters are not acceptable.<br>(ii) The nominal voltage output shall be 230 Volts. Single phase, 50 Hz.<br>(i) Function: To supply uninterrupted power to static switches.<br>(ii) Capacity of each inverter: 100% to rated KVA<br>(iii) Duty: Continuous<br>(iv) Automatic Voltage regulation<br>(v) Smoothing filter circuit if required<br>(vi) Rated output current at rated output voltage with current limit not operating: 200% for 100ms<br>(vii) The inverter shall have sufficient capability to clear fault in the maximum rated branch circuit, limited to 8 % of finally selected ups capacity. |

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| | | | (viii) Inverters and bypass lines shall be synchronized to each other.<br>(ix) The steady state voltage regulation shall be +/-2% and transient voltage regulation (on application/re moval of 100% load) shall be +/-20%. Time to recover from transient to normal voltage shall not be more than 50 mSec.<br>(x) Frequency regulation for all conditions of input s upplies, loads and temperature occurring simultaneously or in any combination shall be better than ± 0.5% (automatically controlled).<br>(xi) The total harmonic content shall be 5% maximu m and content of any single harmonic shall be 3% m aximum.<br>(xii) The inverter efficiency shall be at least 85% on full load and 80% on 50% load.<br>(xiii) The synchronisation limit for maintenance of synchronisation between the inverter and stand by AC source shall be 48-52Hz, field adjustable in steps of 1 Hz. |
| f) | Battery | : | (i) ECV-1.4V for Ni-Cd batteries/1.75V for VRLA Battery<br>(ii) Mounting: On Mild steel corrosion resistant stand/r acks. The Stand/Racks shall be pretreated & epoxy painted/PVC coated. Provision for stand earthing also.<br>(iii) Aging factor: 25%<br>(iv) Make: AMCO/HBL – for Ni-Cd batteries.<br>EXIDE/HBL/AMARA RAJA – for VRLA batteries.<br>Make shall be subject to final approval during orde r execution without any price implications.<br>(v) Sizing calculation:<br>$\text{Battery Current, } I_B = \frac{\text{Inverter rated KVA x 1000 x Load P.F.}}{\text{Inverter efficiency x no. of cells x End Cell voltage}}$<br>Battery Size (AH Rating) = ($I_B$ x Design Margin x Aging factor x Capacity factor x Temperature correction factor)/State of Charge Factor. |
| g) | Transformers/Isolation Transformers: | : | (i) Type: Double wound, Dry type<br>(ii) Purpose: Galvanic isolation of two circuits<br>(iii) Cooling: Natural cooling suitable for panel mount<br>(iv) Class of insulation: Class – H insulation with temp erature rise limited to class –F insulation value. |
| h) | Static switches | : | (i) Function: The static switch shall be provided to pe rform the function of transferring UPS loads automatically without |

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| | | | any break from (a) faulty inverter to healthy inverter in case of failure of one of the two inverters and (b) from faulty inverter to standby AC source in case of failure of both the inverters.<br>(ii) Type: Solid state, SCR<br>(iii) Duty: Continuous<br>(iv) Each switch capacity: Equal to full load capacity of the inverter.<br>(v) Transfer time in synchronized mode: 1/4$^{th}$ cycle maximum<br>(vi) Capability: Must have undergone not less than 1000 transfer/re-transfer cycles at full load.<br>(vii) Continuous and overload capacity of the switches shall be equal to 100% of the continuous and overload rating of each inverter. Peak Capacity shall be 1000% of continuous rating for 5 cycles. |
| i) | Manual bypass switch | : | (i) Function: Manual bypass switch shall be employed for isolating the UPS during maintenance.<br>(ii) Type: Maintained, make before break<br>(iii) Capacity: Make and carry full load current of inverters<br>(iv) Transfer: manual |
| j) | Voltage Stabilizer | : | (i) Required in Bypass line & servo type.<br>(ii) Isolation transformer of appropriate voltage and phase as per system requirement along with associated voltage stabilizer shall be furnished with each UPS system.<br>(iii) The overload capacity of the transformer and voltage stabilizer shall not be less than 300% for 200 millisecond duration. The voltage stabilizer shall employ static type and shall maintain the specified output voltage for 0-100% load with maximum input voltage variations as indicated above. The efficiency of the stabilizer shall be 95% or better. |
| k) | UPS Panels | : | (i) Type: Free standing rack, fitted with suitable louvers, fans, Dust tight gaskets on front and back doors.<br>(ii) Cable entries : Bottom<br>(iii) Gland plate: Removable bolted, 3mm thick<br>(iv) Cable glands : Double compression type Nickel plated brass<br>(v) Front fascia shall be provided with Alpha Numeric L.C.D display with fault logging facilities.<br>(vi) Panel enclosure: CRCA sheet steel of<br>2mm thickness – Load bearing parts<br>1.6mm thickness – Load bearing parts |

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| | | | (vii) The enclosures shall be reinforced with formed steel members as required to form a rigid self-supporting structure. Doors shall have three point latches.<br>(viii) Degree of protection of enclosure : IP-42 (min)<br>(ix) The temperature rise inside all the cabinets/enclosures shall not exceed 10 deg.C above ambient temperature.<br>(x) Inter panel: Removable sheet steel barriers.<br>(xi) Bus bars (with color coded): Required for above 100Amps power circuits.<br>(xii) Air clearance for bare bus bars: Phase to Phase: - 25.4 mm; Phase to earth: - 19.0 mm.<br>(xiii) Numbering: Ferrules, terminals, either end of internal & wiring, external terminals etc.<br>(xiv) Each panel shall be provided with one 5A receptacle and switch.<br>(xv) The cubicles shall be provided with one (1) 240 V AC power supply socket outlet for connecting instruments, hand lamps, etc. during maintenance and testing. Separate power supply shall be provided for this plug and socket arrangement. |
| l) | Fault Diagnostic unit | : | (i) Type: Microprocessor based on line fault diagnostic unit<br>(ii) Function: Monitor UPS operation, identify and locate the faults, to interface customer PC through serial communication, print out facilities during UPS changeover in various conditions & UPS failure.<br>(iii) Provision of hook up with external PC with additional equipment's as required at both ends for establishing connectivity. |
| m) | Output contacts – for remote alarm | : | (i) The UPS shall have inbuilt RS 485 port with MODBUS-RTU for display of online status of UPS on plant remote control system. |
| n) | Indications & components at each Incoming & outgoing Feeders | : | As per annexure-A |
| o) | Additional requirements | : | (i) Reverse Battery polarity protection shall be provided.<br>(ii) Asynchronous transfer facilities shall be provided.<br>(iii) The UPS shall have inbuilt RS 485 port with MODBUS-RTU for display of online status of UPS on plant remote control system.<br>(iv) Adequately rated breakers for continuous rating as well as |

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| | | | breaking capacity. Paralleling of breaker/switch/contactor poles to achieve the required current rating is not acceptable.<br>(v) Double pole output isolation devices.<br>(vi) Designing of all electronic devices like IGBT's, diodes etc. for **150%** of the maximum current carried by the respective device.<br>(vii) Designing of all other components like transformers, reactors, contactors for **110%** of the maximum required rating.<br>(viii)The UPS shall have an overload capacity of 125 % rated capacity for 10 minutes and 150 % rated capacity for 10 seconds.<br>(ix) $I^2t$ co-ordination between fuse and semi-conducting power devices<br>(x) PCB's with transparent epoxy coating.<br>(xi) Looping of all individual panels & bringing them to a common point in the control room for a common point of earthing.<br>(xii) In addition to indications/display on charger panel, alarms along with relevant analog measurements shall also be provided by employing RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for use in DDCMIS. The list of alarm output shall be as approved by Employer during detailed engineering.<br>(xiii)The charger shall be current limited for charger circuit protection and protection of battery from overcharge shall also be provided. The current limit shall be continuously adjustable. The chargers shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energized.<br>(xiv)The overall efficiency of the UPS system, output to input, shall not be less than 90% at 50% of rated load.<br>(xv) The ripple content shall be limited to +/- 2 % of Charger output voltage.<br>(xvi)The UPS system design shall ensure that in case of failure of mains input power supply to one of the chargers, the other charger whose mains input power supply is healthy, shall feed to one or both the inverters as the case may be as per manufacturer's standard practice & continue to charge the D.C. battery at all load conditions. The Bidder should note |

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| | | | that this situation should not in any way lead to the discharge of the D.C. Battery. |
| p) | Loading capability | : | UPS shall be capable of taking 100% non- linear loads. |
| q) | Minimum clearance at bottom end | : | 300 mm from the gland plate<br>From Incoming/Outgoing terminals of the panels to gland Plate to facilitate proper termination of cable glands, and lugs. |
| r) | UPS AC DB for 5KVA UPS | : | Construction : Non- Compartmentalized<br>Design ambient temperature: 50°C<br>Enclosure: CRCA sheet steel of 2.0 mm.<br>Gland plate: 3mm thick Al<br>Mounting: Wall mounted suitable for PEB room(Same shall be finalized during detailed engineering)<br>Enclosure protection : IP-42<br>Incoming feeders: 2nos, 230V AC, 32A DP MCB.<br>Outgoing feeders: 12nos.-10A (230V ,10A DP MCB)<br><br>Additional requirements:<br>i. Incoming cable compartment shall be at the bottom with adequate cable termination height but not less than 300 mm from bottom.<br>ii. The bus bars shall be of aluminium alloy conforming to IS: 5082.<br>iii. The busbar sizes shall be so selected that with the passage of the rated current through the busbars, the temperature rise over 45 ˚C ambient does not exceed 45 ˚C as measured by thermometer.<br>iv. Suitable voltmeter, ammeter, MFM of 96x96 shall be provided.<br>v. Indicating lamps shall be provided at incomer & on each feeder. The lamps shall be cluster LED type<br>vi. DB/body/door etc. earthing provision shall be provided.<br>vii. The internal power wiring of the modules shall be with 1.1 kV heavy duty single core stranded copper conductor PVC cable or copper busbars with adequate spacing.<br>viii. Minimum 20% spare terminals shall be provided on the terminal blocks.<br>ix. Fault level of UPS DB shall be 10KA/sec. |
| s) | UPS AC DB for 10 KVA UPS | | Construction : Non- Compartmentalized<br>Design ambient temperature: 50°C<br>Enclosure: CRCA sheet steel of 2.0 mm<br>Gland plate: 3mm thick Al |

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| | | | Mounting: Wall mounted<br>Enclosure protection : IP-42<br>Incoming feeders: 2nos, 230V AC, 63A MCB.<br>Outgoing feeders: 6nos-16A(230V ,16A DP MCB), 6nos.-32A (230V ,32A DP MCB)<br>Additional features:<br>As mentioned in cl. u (i-ix) of above. |
| t) | Fittings & Accessories | : | Refer Part 1 of Annexure A to this specification |
| ~~u)~~ | ~~Variable Discharge Resistor Bank~~ | : | ~~1No. of Variable Resistor bank shall be provided which is suitable for do testing of 10KVA UPS & 5KVA UPS.~~<br>~~Discharge resistor shall be completely assembled in a 2 mm thick cubicle fitted with bi-directional wheels for charge discharge cycle testing of UPS battery.~~<br>~~• Suitably rated DC MCCB for connecting the battery bank to load bank.~~<br>~~• 3 ‘/2 digit digital D.C Ammeter and voltmeter.~~<br>~~• Cooling Fan of suitable capacity.~~<br>~~• Selector switch for selecting discharge rate at 0.1C5 to C5 in 5 equal steps.~~<br>• ~~Bimetal relay for over temperature trip on each stage.~~ |
| v) | Mandatory Spares | : | Refer Part-3 of Annexure A to this specification |
| w) | Commissioning Spares | | The spares which would be required during plant or equipment testing, start-up and commissioning. These spares have to be supplied along with the main equipment. The list of commissioning spares shall include minimum of following items:<br>Control fuses (Each type & rating) – 1 Set.<br>Nuts / Bolts & washers – 5 nos each.<br>Inter cell connectors – 5 nos.<br>Inter row connectors – 2 nos.<br>Nuts / Bolts & washers – 10nos each.<br>In addition to above, any other spares recommended for commissioning shall also be included. Complete list of commissioning spares to be submitted to BHEL during detail engineering stage for information. |

## 6. INSPECTION & TESTING

All equipment shall be completely assembled, wired, adjusted and tested at the factory as per the relevant IS/IEC standards. The following tests shall however be carried out as a minimum. **All the tests being conducted shall clearly be brought out in the Quality Assurance Plan (QAP) by Bidder. The category of test i.e whether it is a routine test or type test or both, must also be brought out clearly in the QAP with specific mention of relevant standard Number against each test.**

| | | | |
|---|---|---|---|
| a) | BOM verification | : | 100 % Witness |
| b) | Visual check - Dimensional, component verification, polarity verification | : | 100 % Witness |
| c) | Visual check - Electrical wiring: routing, ferruling, tightness | : | 100 % Witness |
| d) | Components internal test certificates | : | Review |
| e) | Burn-in test for PCBs & other electronic components for 96 hours at 50 Deg C | : | Review |
| f) | Routine tests: Insulation test as per IEC 60146-1-1, Interconnection cable checks, No load test, Checking of auxiliary devices, Output voltage tolerance, Temperature Rise Test, Output frequency tolerance, Efficiency checks at rated p.f. for 50%, 75% & 100% load, functional tests etc. | : | Review |
| g) | All type tests shall be as per the relevant IS/IEC standard. | : | Review |
| h) | Typical Functional tests – Light load test, Checking of auxiliary devices, Synchronization Test, A.C input failure test, A.C input return test, Simulation of parallel redundant UPS fault, Transfer test, Full load test, Efficiency, Actual load test, Ventilation Test, Overload capability test, Short circuit current capability, Short circuit fuse test, Restart, Output over voltage, periodic output voltage modulation, harmonic components, Earth fault test,HV & IR test, Over voltage protection test etc., | : | 100 % Witness |
| i) | Battery tests: Rated Stored Energy Time, Rated Restored Energy Time, Battery Ripple Current & other test as per applicable standards. | : | 100 % Witness |
| j) | Wall Mounded UPS ACDB : As per applicable standards | : | 100 % Witness |

**7. Cable scope Matrix**

| SL No. | Cable From | Cable to | Cable Type [Type/OD/No of Runs] | Scope of Cable |
|---|---|---|---|---|
| a) | BHEL Panels | UPS Incomer | During order execution | BHEL |
| b) | UPS Panels (Rectifiers/Chargers) | Battery Isolation box | During order execution | BHEL |
| c) | Battery isolation box | Battery | During order execution | BHEL |
| d) | UPS Outgoing terminals | UPS AC DB | During order execution | Bidder |

**NOTES:**

1. The Supply of Cables & accessories (glands & lugs) for internal cable connections within the UPS Panels are by UPS bidder. The supply of Cable accessories for BHEL supplied cables terminating at UPS, Battery & isolation box end as listed above are also by the UPS bidder.
2. Bidder shall consider suitable terminals at the respective equipment end for terminating these cables.

## 8. DOCUMENTATION

8.1 Following information has to be necessarily submitt ed as a part of the Technical Bid. Bidder shall make the offer in detail, with respect to every item of the Purchaser's specifications. Any offer not conforming to this shall be summarily rejected.

| Sl .No | Description |
|---|---|
| 1. | UPS Single line diagram. |
| 2. | General Arrangement & equipment drawings with dimensions of Battery, UPS & other equipment in Bidder's scope. |
| 3. | Functional Description indicating the various Opera ting modes |
| 4. | List of indications, Alarms & Metering. |
| 5. | Bill of Materials. |
| 6. | Data Sheets as per the format in the annexure (Annexure A Part 5) to this document. |
| 7. | Calculation for sizing of Inverter, Battery, Battery Chargers, input/output isolation & bypass Transformers, major electronic power devices like thyristor, static switches, IGBT's etc. and other components like busbar's, isolation breakers, contactors etc. |
| 8. | Signed and stamped technical specification, |
| 9. | Technical catalogues/leaflets on :<br>1) Battery 2) Battery charger 3) Inverter 4) Static switch 5) Manual by- pass switch. |
| 10. | Technical Deviation list in the deviation schedule format indicated in this document. |
| 11. | PTR's with supporting documents/catalogues. |
| 12. | Valid Type test certificates not older than 10 years as on date of tendering |
| 12. | Recommended Spares List for 5 years trouble free operation |
| 13. | Unpriced format of the above price schedule indicating quoted/not quoted. |

8.2 **To be submitted after award of contract :**

| Sl. No | Document | Submission Schedule | Category |
|---|---|---|---|
| 1. | All documents as specified at Cl 7.1 above for submission along with offer | Within 1 week from PO | A |
| 2. | Dimensional battery layout diagram in plan & sections. | Within 1 week from PO | A |
| 3. | UPS panel & Battery foundation plan and loading details. | Within 1 week from PO | A |
| 4. | UPS schematics and wiring diagrams. | Within 1 week from | A |
| 5. | Connection details of take-off terminals. | Within 1 week from PO | A |
| 6. | Detailed bill of materials & make of the components | Within 1 week from PO | A |
| 7. | Handling instructions | Within 1 week from PO | I |

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| 8. | List of Routine tests, type tests & functional tests with specific mention of relevant standard Number. | Within 1 week from PO | R |
| 9. | Comprehensive Quality Assurance plan (QAP). | Within 1 week from PO | A |
| 10. | As-manufacture drawing | 1 week after inspection | I |
| 11. | Operation & Maintenance manual | Within 2weeks from PO. | A |
| 12. | Site Acceptance Test(SAT) Procedure | 1 weeks prior to inspection | A |
| 13. | As built drawings | Within 2 weeks from commissioning completion date. | I |

Note: 1) BHEL will furnish Comments within 1 week from receipt of the Drawings.
2) Vendor to submit revised drawings/documents with in 1 week from BHEL's comments date.

8.3 To be submitted after inspection. **(Note: submission of these documents are commercially linked)**

a) Complete O& M manual – all in 16 sets (14 sets to be included with item dispatch and balance to BHEL purchase department).
b) Approved Engineering documents
c) Guarantee and all test certificates for review and acceptance by BHEL and / or BHEL's Customer

2 sets of CD-ROM – containing **O&M manual and Engineering documents** (1 set to be included with item dispatch and balance to BHEL purchase department).

## 9. PACKING AND DESPATCH

All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. It shall be wrapped in polythene sheets before being placed in crates/cases to prevent damage to finish. The crates/cases shall have skid bottoms for handling. Special notations such as Fragile, This side up, Center of gravity, Weight, Owner's particulars, PO no. etc., shall be clearly and indelibly marked on the packages together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains and high ambient temperature unless otherwise agreed.

**10. DEVIATION SCHEDULE (TECHNICAL)**

| Sl.No. | Cl.No./Page No./Sec No. | Description as specified | Deviation taken | Remarks/ Reason for Deviation |
|---|---|---|---|---|
| | | | | |

**NOTES:**

1. Bidder may give a consolidated list of deviations in this form only. Only the deviations listed here in conjunction with the original tender, shall constitute the contract document for the award of the job to the Bidder.
2. Deviation listed elsewhere shall be ignored & will be summarily rejected.
3. If there are no deviations, bidder shall submit signed copy of this format, mentioning "No Deviations" & it shall be henceforth implied that Bidder is complying to all the clauses of the bidding document.
4. Attach more sheets in this format, if required.

(**Signature of the Vendor**)

**11. CHECK LIST:**

**(TO BE FILLED BY BIDDER AND SUBMITTED ALONG WITH TECHNICAL OFFER)**

Enquiry No. Date :
Name of the Bidder :
Project :
Specification No : PY55207, Rev02
Item : 230V, 5KVA & 10KVA UPS Package

| Sl. No. | Check point description | Supplier Confirmation (✓) |
|---|---|---|
| 1. | Completely filled-in Technical Data sheet as per specification enclosed. | |
| 2. | UPS Single line diagram enclosed. | |
| 3. | Duly signed Deviation Schedule(Technical) enclosed | |
| 4. | Relevant Type Test Certificates enclosed | |
| 5. | Unpriced Schedule enclosed as per BHEL specification complying to following:<br>1. Signed & Stamped<br>2. In BHEL format.<br>3. All items are quoted | |
| 6. | Unit price list of Mandatory spares as mentioned at part-3 of annexure-A to PY55207,Rev02 | |
| 7. | Following documents enclosed for information<br>1. Battery GA<br>2. UPS GA<br>3. ACDB GA | |
| 8. | Following equipment calculations enclosed for infor mation<br>1. Battery Charger<br>2. Battery<br>3. Input/output isolation & bypass Transformers | |
| 9. | List of commissioning spares | |
| 10. | List of O&M spares (Recommended) for 5 years of plant operation (Unpriced) enclosed | |
| 11. | Catalogues enclosed | |
| 12. | Clause wise confirmation to BHEL specification included in technical offer except the deviations listed in deviation schedule. | |

**Note:** Bidder to submit **this checklist** duly filled & signed along with the Offer. No deviation is acceptable in this regard. Without duly signed & stamped checklist, offer shall not be considered for evaluation.

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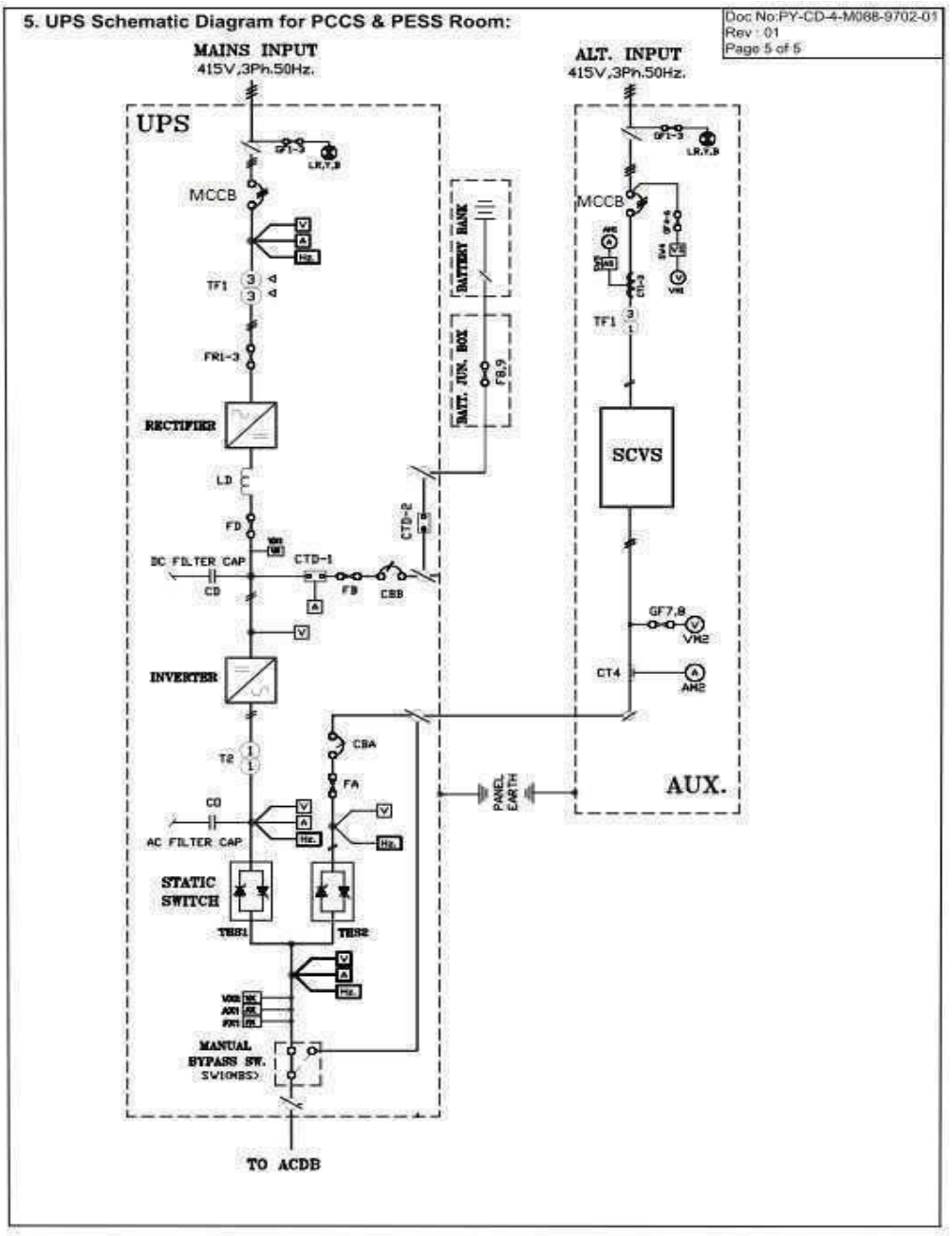
BIDDER'S STAMP & SIGNATURE

**12. UPS LINE DIAGRAMS(TYPICAL) :**

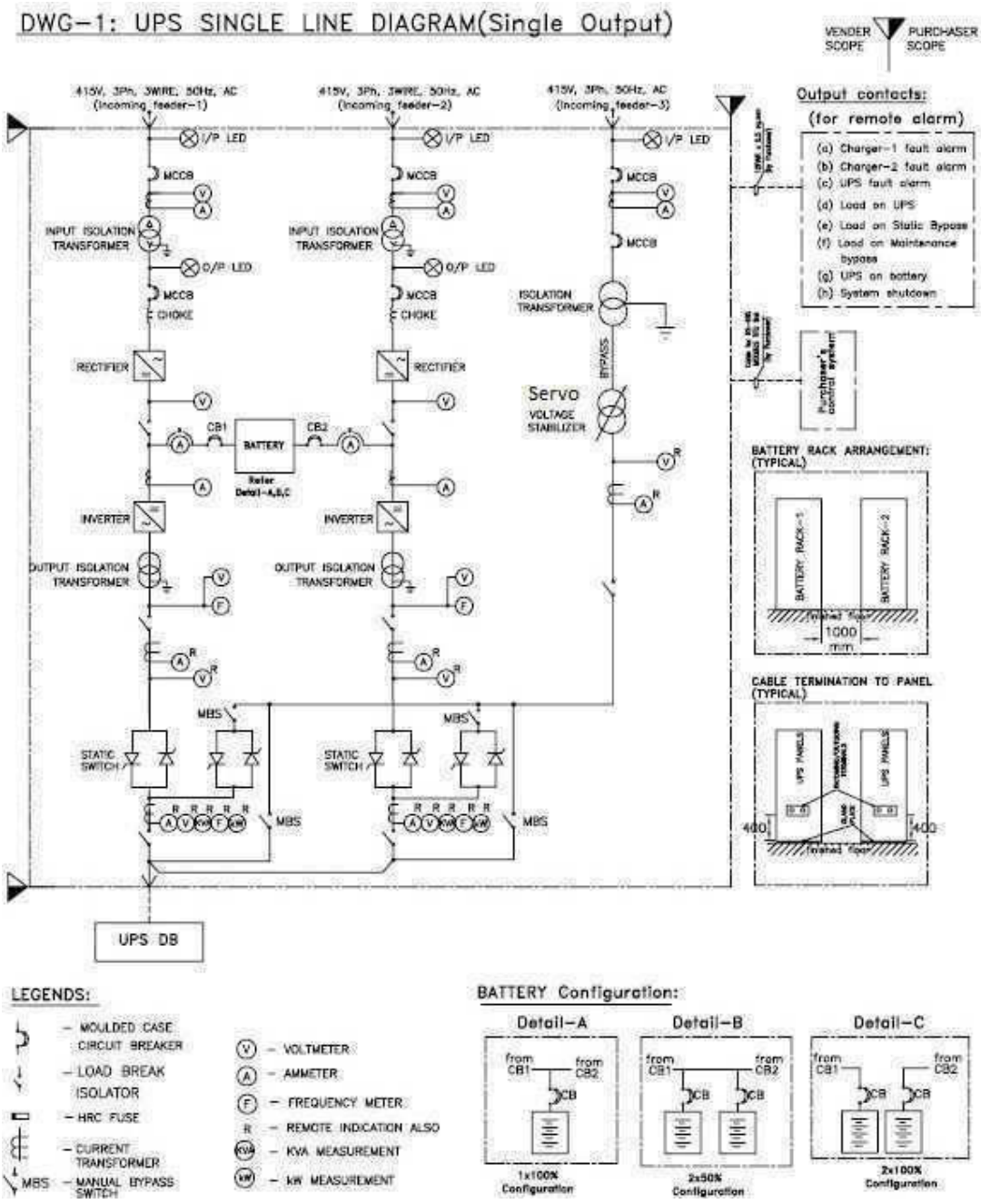
**12.1 5KVA UPS SLD(TYPICAL) :**

The line diagrams with components & accessories indicated below are typical only. The fittings & accessories shall be as per the list at Annexure A Part 1.




Drawing no. 12.1 Typical SLD for 5 KVA & 10KVA UPS

**12.2 <u>10 KVA UPS SLD(TYPICAL)</u> :**




Battery Configuration to be followed: **Detail – C**

Bypass – **Servo Voltage Stabilizer**

Drawing no. 12.2 <u>Typical SLD for 10KVA UPS</u>

Ref. Doc

**13. DESIGN VARIABLES**

**Following design variables shall be finalized during drawing approval. It is Bidder's responsibility to obtain BHEL clearance on the same and shall comply without any commercial implications:**

| | | | |
|---|---|---|---|
| 1) | UPS earthing /grounding | : | Normally UPS shall be designed for floated output. In case of "grounded UPS" to be intimated during drawing approval. |
| 2) | Sizes for BHEL supplied cables | : | To be intimated during order execution |
| 3) | Cable entry to UPS panel | : | From bottom or Top |
| 4) | UPS panel outside colour | : | To be intimated during order execution |
| 5) | Battery Make | : | One of the approved make from list given above. |

**14. Material Code (For BHEL use) :-**

| Sl.No | Description | Material Code |
|---|---|---|
| 01 | 5KVA UPS, 1X100% Ni-Cd Battery | PY9755207015 |
| 02 | 10KVA UPS, 1X100% Ni-Cd Battery | PY9755207023 |
| 03 | Variable Resistor Bank for 10KVA UPS Battery | PY9855207040 |
| 04 | Supervision of E&C of 5KVA UPS | PY9755207050 |
| 05 | Supervision of E&C of 10KVA UPS | PY9755207068 |
| 06 | 5 KVA_MCCB,MCB of each type & rating | PY9755207074 |
| 07 | 5 KVA_A.C Fuse each type & rating | PY9755207082 |
| 08 | 5 KVA_D.C Fuse each type & rating | PY9755207090 |
| 09 | 10 KVA_MCCB,MCB of each type & rating | PY9755207108 |
| 10 | 10 KVA_A.C Fuse each type & rating | PY9755207116 |
| 11 | 10 KVA_D.C Fuse each type & rating | PY9755207124 |
| 12 | Inverter Room DB_ MCB of each Type & rating | PY9755207155 |
| 13 | CMCS Room DB_ MCB of each Type & rating | PY9755207163 |
| 14 | 5KVA UPS, 1X100% SMF VRLA Battery | PY9755207180 |
| 15 | 10KVA Parallel Redundant UPS, 2X100% SMF VRLA Battery | PY9755207198 |
| 16 | 5 KVA_Push Button and Switches | PY9755207205 |
| 17 | 5 KVA_Terminal Block | PY9755207214 |
| 18 | 10 KVA_Push Button and Switches | PY9755207226 |
| 19 | 10 KVA_Terminal Block | PY9755207238 |

ANNEXURE- I

**VENDOR LIST FOR ELECTRICAL COMPONENTS**

i) The acceptable makes of electrical components are as follows:

| ITEM | MAKES |
|---|---|
| CABLE LUGS & GLAND | 1. BALIGA LIGHTING EQUIPMENTS (P) LIMITED<br>2. COMET BRASS PRODCUTS<br>3. COMET INDUSTRIES<br>4. FCG FLAMPROOF CONTROL GEARS P. LTD (C-157)<br>5. FCG POWER INDUSTRIES PVT LTD<br>6. FLAMEPROOF EQUIPMENTS PVT.LTD<br>7. FLEXPRO ELECTRICALS PVT LTD<br>8. PROMPT ENGINEERING WORKS<br>9. STANDARD METAL INDUSTRIES<br>10. SUDHIR SWITCHGEARS PVT LTD<br>11. DOWELLS |
| CABLE | 1. CCI<br>2. UNIVERSAL<br>3. ASIAN<br>4. NICCO<br>5. PLOYCAB<br>6. RPG<br>7. KEI<br>8. CRISTAL<br>9. FINECAB<br>10. HAWELLS |
| CONTACTOR | 1. ABB LTD (BANGALORE)<br>2. BCH ELECRTIC<br>3. CONTROLS & SWITCHGEARS CONTACTORS LTD<br>4. GE INDIA INDUSTRIAL PVT LTD<br>5. LARSEN & TOUBRO LTD<br>6. SCHNEIDER ELECTRIC INDIA PVT LTD<br>7. SIEMENS LIMITED<br>8. ALCON |
| CONTROL SWITCH / SELECTOR SWITCH | 1. AREVA T & D INDIA LTD (T&D GROUP)<br>2. HAVELL'S INDIA PVT LTD<br>3. HOTLINE SWITCHGEAR & CONTROLS<br>4. KAYCEE INDUSTRIES LTD.<br>5. LARSEN & TOUBRO LTD<br>6. RELIABLE ELECTRONIC COMPONENTS PVT LTD<br>7. SIEMENS LIMITED |

| | |
|---|---|
| FUSE SWITCH COMBINATION | 1. ABB LTD (BANGALORE)<br>2. CONTROLS & SWITCHGEAR CO LTD<br>3. HAVELL'S INDIA PVT LTD<br>4. INDO ASIAN FUSEGEAR LTD<br>5. LARSEN & TOUBRO LTD<br>6. SCHNEIDER ELECTRIC INDIA PVT LTD<br>7. SIEMENS LIMITED<br>8. STANDARD ELECTRICALS LTD |
| FUSE | 1. GE INDIA INDUSTRIAL PVT LTD<br>2. INDO ASIAN FUSEGEAR LTD<br>3. LARSEN & TOUBRO LTD<br>4. SIEMENS LIMITED<br>5. COOPER BUSSMAN |
| IGBT/DIODE/SCR | 1. ABB<br>2. SEIMENS<br>3. SEMIKRON<br>4. IXYS |
| TIMER | 1. BHARTIA INDUSTRIES LTD<br>2. ELECTRONIC AUTOMATION PVT LTD<br>3. LARSEN & TOUBRO LTD<br>4. SIEMENS LIMITED |
| MCB | 1. SIEMENS<br>2. MDS<br>3. DATAR SWITCHGEAR PVT LTD.<br>2. HAVELL'S INDIA PVT LTD<br>3. INDIANA CURRENT CONTROL LTD<br>4. INDO ASIAN FUSEGEAR LTD<br>5. LEGRAND (INDIA) PVT. LTD (FORM. M-006<br>6. STANDARD ELECTRICALS LTD<br>7. GE INDIA INDUSTRIAL PVT LTD |
| MCCB | 1. GE INDIA INDUSTRIAL PVT LTD<br>2. LARSEN & TOUBRO LTD<br>3. SCHNEIDER ELECTRIC INDIA PVT LTD<br>4. CROMPTON<br>5. SEIMENS<br>6. ABB<br>7. BCH<br>8. ANDREW YULE |
| METER | 1. AREVA T & D INDIA LTD (T&D GROUP)<br>2. AUTOMATIC ELECTRIC LTD.<br>3. MECO INSTRUMENTS PVT LTD<br>4. NIPPEN ELECTRICAL INSTRUMENTS CO.<br>5. RISHABH INSTRUMENTS PVT LTD |

| | |
|---|---|
| PUSH BUTTON AND INDICATING LAMP | 1. BHARTIA INDUSTRIES LTD<br>2. CONTROLS & SWITCHGEARS CONTACTORS LTD<br>3. HOTLINE SWITCHGEAR & CONTROLS<br>4. LARSEN & TOUBRO LTD<br>5. PRECIFINE PRODUCTS PVT. LTD.<br>6. SCHNEIDER ELECTRIC INDIA PVT LTD<br>7. SHRI TULSI SWITCHGEARS PVT LTD<br>8. SIEMENS LIMITED<br>9. BCH ELECTRIC<br>10. TEKNIC CONTROLS<br>11. BINAY |

(ii) Contractor/ vendor while ordering shall ensure the availability of spare parts and maintenance support services for the offered equipment at least for 15 years from the date of supply.

(iii) Contractor/ vendor shall give a notice of at least one year to the end user of equipment and PMC before phasing out the products/spares to enable the end user for placement of order for spares and services.

(iv) Vendor shall confirm to the makes of (indigenous) component such as switch fuse unit, IGBT/DIODE/SCR, MCCBs, MCBs, push buttons, indicating lamp and contactors etc., as per above vendor list at (i). **Deviation to this shall not be acceptable**.

(v) For makes of items not listed in the above vendor list/except items mentioned at note-iv, prior approval from BHEL is mandatory. The makes chosen shall have sufficient PTR, preferably where BHEL approvals were taken earlier.

**RECORD OF REVISIONS**

| Rev. No. | Date | Revision Details | Revised | Approved |
|---|---|---|---|---|
| 00 | 04/06/2016 | Original issue | ---- | Sd/-<br>(J K Pattanaik) |
| 01 | 27/07/16 | Generally revised as per NLC project requirement | Sd/-<br>Ch Mahesh | Sd/-<br>P Suresh |
| 02 | 24/08/16 | 10KVA UPS changed to parallel redundant with 2X100% battery | Ch Mahesh | P Suresh |
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**ANNEXURE-1 TO PURCHASE SPECIFICATION**
**FO R**
**UPS DOC NO. PY55207-Rev 02**

# PROJECT SPECIFIC DATA

**PROJECT:** *65Mwp SOLAR PV POWER PLANT*

**CUSTOMER:** *M/s NEVELI LIGNITE CORPORATION LTD NTPC, NEYVELLI, TAMILNADU*

Ref. Doc

## CONTENTS

Ref. Doc

# PART 1
# FITTINGS & ACCESSORIES

The minimum list of Fittings & Accessories to be included for each of the UPS Package is listed below. Bidder shall include all accessories over & above that indicated here to make the UPS system functionally complete with reliable operation & maintenance.

**1. METERING:**

1.1. **AC Incoming supply**

Following metering shall be provided for each incomer & bypass line.

a) Input line voltages for all the three phases with selector switch
b) Input line currents for all the three phases with selector switch

1.2. **Rectifiers**

Following metering shall be provided for each individual rectifier.

a) DC Voltage at each rectifier output
b) DC Current at each rectifier output
c) Battery Charging/Discharging Current

1.3. **Inverters**

Following metering shall be provided for each individual inverter.

a) DC Current at each inverter input
b) Output line voltages for all the three phases with selector switch (To be measured after the static switch)
c) Output line currents for all the three phases with selector switch (To be measured after the static switch)
d) Frequency meter(digital type)
e) Power factor meter

1.4. **Stabilized bypass supply**

a) Output Voltage of Servo Voltage Stabilizer
b) Output Current of Servo Voltage Stabilizer
c) By pass transformer secondary voltage
d) Input frequency

**2. INDICATIONS:**

2.1 **AC Incoming supply**

Following indication shall be provided for each incomer & bypass line.

a) AC Mains ON

2.2 **Rectifiers**

Following indication shall be provided for each individual rectifier.

a) Rectifier Output ON

2.3 **Static transfer switch**

Following indication shall be provided for each Static Transfer Switch.

a) Switch in 'Normal' position (with red indicating lamp)
b) Switch in 'Standby' position (with green indicating lamp)
c)'Normal and Standby' power source are in synchronism (with white indicating lamp)
d) Static switch inhibited (on account of poor quality of bypass line)

2.4 **Miscellaneous**

a) Load on Inverter A/Inverter B
b) Load on Bypass

c) Battery on Float Charge (for each battery)
d) Battery on Rapid charge (for each battery)
e) Battery output 'ON'
f) By pass supply 'ON'

'Red' LED shall be provided for ON indication, 'green' for OFF condition and 'amber' for fault condition.

**3. AUDIO VISUAL ALARM (Complete with Accept/Reset/Test facilities over separate push buttons) :**

3.1 **AC Incoming supply**

Following alarms shall be provided for each incomer & bypass line.

a) Mains under voltage/ single phasing

3.2 **Rectifiers**

Following alarms shall be provided for each individual rectifier.

a) Cooling fan tripped (common for all fans)
b) Rectifier/diode fuse failure

3.3 **Inverters**

Following alarms shall be provided for each individual inverter.

a) Inverter output voltage - Low (delayed to avoid alarm on load inrush)
b) Inverter Overloaded
c) Inverter temperature high
d) DC input failure
e) Inverter – I output failure
f) Inverter – II output failure
g) Load-on bypass
h) SCR/IGBT fuse failure
i) UPS output under voltage
j) Inverter fault

3.4 **Static transfer switch**

Following indication shall be provided for each Static Transfer Switch.

a) Static switch transfer to standby position.
b) Standby source voltage deviation (greater than plus or minus 2 percent) from normal.

3.5 **Miscellaneous**

a) Bypass inhibit
b) Static Switch faulty
c) Individual Fan failure (if provided)
d) Battery Discharged/Low battery voltage (for each battery)
e) Battery Circuit breaker Open
f) UPS Output Failure
g) Low battery voltage
h) DC over-voltage
i) Battery earth fault
j) Mains failure

**4. ACCESSORIES FOR OPERATION:**

4.1. **Rectifiers**

Following accessories shall be provided for the operator control of each individual rectifier.

a) 3-pole circuit breaker for charger input
b) Charger ON-OFF push buttons
c) Selector switch for selecting 'Float Charge' 'Equalizing charge' or' Boost Charge'
d) Independent potentiometer with manual adjustment knobs for 'Float voltage adjust', 'Equalizing voltage adjust' and 'Boost voltage adjust'
e) Equalizing charge timer (0-72) Hrs with manual reset
f) Charging rate setter
g) 3-position spring return to center selector switch along with two number indicating lights for ground fault detector
h) Ground detector relay
i) Alarm reset push button

4.2. **Inverters**

Following control accessories shall be provided for the operator control of each individual inverter.

a) Inverter ON-OFF switch
b) Alarm reset push button

4.3. **Battery**

Following accessories shall be provided for each UPS battery for complete battery installation, testing & maintenance.

| Sl.No | Description | Requirements | Quantity |
|---|---|---|---|
| 1. | Battery stand (In stackable Module form) | | 1 Set |
| | Material | Mild steel corrosion resistant painted with three coats of anti-acid paint of approved shade battery stand and cable supports shall be provided. The stand shall be pretreated and 2coats of epoxy /PVC coated. | |
| | Accessibility | Each cell shall be easily accessible for inspection. | |
| 2. | Connectors | Material: PVC, Lead plated copper for Inter cell, Inter stack and flexible cu cable for Interbank connections with full insulation or with suitable insulation shrouds. | As required + 3% Extra |
| 3. | Cell testing DC Voltmeter | Range: Suitable leads for measuring cell voltage (-3, 0, +3 volts) | 2 no's |
| 4. | Set of insulated Spanners | -- | 2 No's |
| 5. | Minimum and max. temperature indicator for each battery | | 1 no. |
| 6. | Battery maintenance record book | | 5 no's |

| | | | |
|---|---|---|---|
| 7. | Corrosion preventive Petroleum jelly | | Required quantity |
| 8. | Bolts, nuts & Washers (As required for complete installation with 5% extra) | Bolts and nuts, for connecting the cells, shall be effectively lead-coated to prevent corrosion | Required quantity with 5% extra |
| 9. | Thermometer with temperature correction chart | | 1 no. |
| 10. | Instruction card | -- | 5 no's |

4.4. **Static Transfer Switch**

a) Push button to simulate Transfer- Test: 1 no.
b) Push button to simulate manual retransfer of static switch to 'Normal' position. : 1 no.
c) Alarm reset push button: 1 no.

## PART-2 DELIVERY SCHEDULE

The indicative delivery schedule for supply of UPS are provided below. However, the same will be discussed and mutually agreed during Kick off meeting/ drawing approval.

| S. No | Item | Quantity | Delivery Date |
|---|---|---|---|
| 1 | Complete UPS System package of 5 kVA with ACDB & 1x100% VRLA battery & its associated items & it's supervision of E&C. | 5 Sets | 13 weeks from date of PO |
| 2 | Complete UPS System package of 5 kVA with ACDB & 1x100% VRLA battery & its associated items & it's supervision of E&C. | 6 Sets | 17 weeks from date of PO |
| 3 | Complete UPS System package of 10 kVA Parallel redundant UPS with ACDB & 2x100% VRLA battery & its associated items & it's supervision of E&C. | 2 Sets | 17 weeks from date of PO |

## PART-3 (MANDATORY SPARES)

| SL.No. | Item Description | Quantity |
|---|---|---|
| 1. | 5 KVA UPS_MCCB,MCB of each type & rating | 1Set (1 Set = 1no. each type & rating for 5KVA UPS) |
| 2. | 5 KVA UPS_A.C fuse/fuse links of each type & rating | 1Set (1 Set = 10% installed quantity in 11 no. of 5KVA UPS & min. 1no.) |
| 3. | 5 KVA UPS_D.C fuse/fuse links of each type & rating | 1Set (1 Set = 10% installed quantity in 11 no. of 5KVA UPS & min. 1no.) |
| 4. | 5 KVA UPS_ Push Button and Switches | 1Set (1 Set = 10% installed quantity in 11 no. of 5KVA UPS & min. 1no.) |
| 5. | 5 KVA UPS_ Terminal Block | 1Set (1 Set = 10% installed quantity in 11 no. of 5KVA UPS & min. 1no.) |
| 6. | 10 KVA UPS_MCCB,MCB of each type & rating | 1Set (1 Set = 1no. each type & rating for 10KVA UPS) |
| 7. | 10 KVA UPS_A.C fuse/fuse links of each type & rating | 1Set (1 Set = 10% installed quantity in 2 no. of 10KVA UPS & min. 1no.) |
| 8. | 10 KVA UPS_D.C fuse/fuse links of each type & rating | 1Set (1 Set = 10% installed quantity in 2 no. of 10KVA UPS & min. 1no.) |
| 9. | 10 KVA UPS_ Push Button and Switches | 1Set (1 Set = 10% installed quantity in 2 no. of 10KVA UPS & min. 1no.) |
| 10 | 10 KVA UPS_ Terminal Block | 1Set (1 Set = 10% installed quantity in 2 no. of 10KVA UPS & min. 1no.) |

## PART-4 (PURCHASERS DATA FOR UPS)

| Sl. no. | DESCRIPTION | PURCHASER'S DATA |
|---|---|---|
| 1.0. | **SITE CONDITIONS** | |
| 1.1. | Site Ambient Temperature | Max 50°C, Min 3°C |
| 1.2. | Design Ambient Temperature | 50°C |
| 1.3. | Maximum Relative Humidity | 100% |
| 1.4. | Atmosphere | Corrosive Industrial |
| 1.5. | Altitude above MSL | 87 meters |
| 1.6. | Seismic Zone | As Per IS 1893 (I) latest version |
| 1.7. | Location | Neyvelli,Tamilnadu |
| 2.0. | **COMMON TECHNICAL REQUIREMENTS** | |
| 2.1. | Input Voltage, frequency & phase | 415V, +10% to -10% in voltage , 50Hz ±5%, 3 PH & Neutral |
| 2.2. | Input Fault Level | 50kA/sec |
| 2.3. | Rated Load Power factor | 0.8 to unity at rated power factor |
| 2.4. | Min. Input P.f. of UPS | 0.85 |
| 2.5. | UPS Rating | **5KVA( 11-Set) & 10 kVA (2-Set)** |
| 2.6. | Quantity | As above |
| 2.7. | Enclosure Ingress Protection | Min. IP 42 or Better |
| 2.8. | Maximum Noise Level | 75 dB at 1m distance |
| 2.9. | Type of Cable Entry | Bottom |
| 2.10. | Type of Painting | 631 of IS-5 (shall be confirmed during detail engineering) |
| 2.11. | Online Fault Diagnostic Unit | Applicable |
| 2.12. | Communication interface | Shall have RS 485 communication multi-drop port and MODBUS protocol, in order to monitor the status of the system. The unit shall also be provided with LCD display with a data logger facilities to log atleast 100 faults on real time basis. |
| 2.13. | Overall Efficiency | > 90% at 50% load & 0.8 p.f. |
| 2.14. | Maximum current distortion at input | ± 15% THD or better |
| 2.15. | No. of Outgoing feeders | 1 No's single phase |
| 2.16. | Distance between UPS panel & batteries | < 10 meters |
| 2.17. | Sheet Steel thickness | Min. 2 mm for load bearing & 1.6mm for non-load bearing structures |

| | | |
|---|---|---|
| 2.18. | Signals required for remote interface in SCADA (Potential free 'NO' contacts rated for 1A, 220V DC wired up to terminal strip and to be grouped separately for charger and inverter unit) | 1 set of the following:<br><u>From Charger Panel</u><br>• Mains under voltage/single phasing<br>• Charger/Diode failure<br>• Cooling fan tripped (Common for all fans)<br>• Low battery voltage<br>• DC over-voltage<br>• Battery Earth fault<br><u>From Inverter Panel</u><br>• DC input failure<br>• Inverter output failure<br>• Load-on bypass<br>• SCR fuse failure<br>• UPS output under voltage<br>• Any other important signals(decided during detailed engineering) |
| 2.19. | Quantity of isolation transformers per set of UPS | • 1 each for isolation in each of the rectifier input & charger output<br>• 1 in the bypass circuit (By pass transformer shall be natural air-cooled type suitable for indoor location. Links shall be provided on 415V windings to give offload tapings of +2.5% & +5% of normal voltage) |
| 2.20. | Additional facilities inside the panel | • 40 W CFL controlled through door switch.<br>• 15A Power socket |
| 2.21. | Type of Earthing | Floating as suitability for 1 leg earthing |
| 3.0. | **DETAILED TECHNICAL REQUIREMENTS** | |
| 3.1. | **INVERTER** | |
| 3.1.1. | Rating | 5KVA( 11-Set) & 10 kVA (2-Set) |
| 3.1.2. | Quantity for each set of UPS | 1 Nos for 5KVA UPS & 2 Nos for 10KVA UPS |
| 3.1.3. | Type | Solid State, IGBT |
| 3.1.4. | Duty | Continuous |
| 3.1.5. | Output Voltage | 230V |
| 3.1.6. | Efficiency | |
| a) | Full Load | Min. 90% |
| b) | Part Load | -- |

| | | |
|---|---|---|
| 3.1.7. | Overload Capacity | 110% rated load for 1hour, 125% rated load for 10 minute, 150% for 10 sec |
| 3.1.8. | Output Voltage Regulation | |
| a) | Steady state (0-100% load at all input voltages and all power factors) | ±1% |
| b) | Transient Voltage on application or removal of 100% load for single UPS and hot standby UPS configuration | ± 8% |
| c) | Transient Voltage on application or removal of 50% load for parallel redundant UPS | ± 10% |
| d) | Time to recover from transient to normal voltage | 100 millisecs |
| 3.1.9. | Synchronization limits of frequency (for maintenance of synchronism between inverter and standby) | ±1.5% |
| 3.1.10 | Field adjustment range of synchronization frequency | ±1% to ±4% in steps of 0.5% |
| 3.1.11 | Steady state frequency variation (0-100% load at all input voltages and all power factors) | ± 0.5% |
| 3.1.12 | Maximum allowed phase displacement between inverter & bypass | ±5° |
| 3.1.13 | Frequency Range for all condition of input supplies, loads and temperature occurring simultaneous or in any combination (automatically controlled) | ± 3% |
| 3.1.14 | Maximum Total Harmonic Content in output | ± 5% |
| 3.1.15 | Harmonic content for any single harmonic | ± 3% |
| 3.1.16 | Maximum ripple current at output | <5% |
| 3.1.17 | Type of Cooling | Natural Convection or forced cooling using redundant fans |
| 3.2. | **RECTIFIER/CHARGER** | |
| 3.2.1. | Quantity for each set of UPS | 1 Nos for 5KVA UPS & 2 Nos for 10KVA UPS |
| 3.2.2. | Type | Float Cum Boost |
| 3.2.3. | No. of Pulses | 6 |
| 3.2.4. | Maximum ripple current at output | <5% |
| 3.2.5. | Efficiency | Min. 90% at Full Load |
| 3.2.6. | Time required to restore the charge of a fully discharged battery | 10 hours |
| 3.2.7. | Requirement of Battery Isolation Box | Yes |
| 3.2.8. | Type of Cooling | Natural Convection or forced cooling using redundant fans |
| 3.2.9. | Blocking Diode PIV | 1200V (min.) |

| | | |
|---|---|---|
| 3.3. | **BATTERY** | |
| 3.3.1. | Type | VRLA |
| 3.3.2. | Quantity for each set of UPS | 1 Nos for 5KVA UPS & 2 Nos for 10KVA UPS |
| 3.3.3. | Sizing of each battery | As per cl. 5 (g) of PY55207 |
| 3.3.4. | Battery configuration | 1x100% for 5KVA UPS & 2x100% for 10KVA UPS |
| 3.3.5. | Design Margin | 10% |
| 3.3.6. | Battery Backup time | 4-hrs |
| 3.3.7. | State of charge factor | 1.0 |
| 3.3.8. | Ageing factor | 1.25 |
| 3.3.9. | Min. Ambient for Battery Sizing | 5°C |
| 3.3.10 | Type of mounting | On Mild steel stand/racks |
| 3.3.11 | End Cell Voltage | 1.75 at $27^0$C |
| 3.3.12 | Single cell Nominal voltage | 2.0 V |
| 3.4. | **DC-DC Converter** | **Not Applicable** |
| 3.4.1 | ~~Output Voltage~~ | ~~110V~~ |
| 3.4.2 | ~~Output voltage variation~~ | ~~+/ 1%~~ |
| 3.4.3 | ~~Efficiency~~ | ~~Min. 90% at Full Load~~ |
| 3.4.3 | ~~Ripple factor~~ | ~~<2%~~ |
| 3.5. | **STATIC SWITCH** | |
| 3.5.1. | Short time rating/Overload Capacity | 125% of rated kVA for 2 min. |
| 3.5.2. | Peak Capacity | 1000% of continuous rating for 5 cycle |
| 3.5.3. | Normal Voltage | 230V |
| 3.5.4. | Transfer time between inverter & bypass in synchronized mode | 4 msec |
| 3.5.5. | Conditions of Load transfer from inverter to bypass | |
| a) | Allowable Range of Stabilizer output voltage | ± 5% of rated UPS output voltage |
| b) | Allowable Range of mains bypass frequency | ± 4% |
| 3.5.6. | Output voltage regulation of stabilizer bypass for complete range of load | ± 2% |
| 3.6. | **MANUAL BYPASS SWITCH** | |
| 3.6.1. | Short time rating/Overload Capacity | 125% of rated kVA for 15 min and 150% for 60sec |
| 3.6.2. | Voltage | 600V |
| 3.7. | **BY PASS VOLTAGE STABILIZER** | |
| 3.7.1 | Type | Servo controlled type |
| 3.7.2 | Output voltage regulation | +1% for 0-100% load variation and full range of input supply variation over the entire power factor range. |
| 3.9 | **UPS ACDB for 5KVA UPS** | Applicable |
| 3.9.1 | Quantity | 10 nos. |
| 3.9.2 | Voltage | 230V,AC |

| | | |
|---|---|---|
| 3.9.3 | IP | 42 |
| 3.9.4 | Sheet Steel thickness | Min. 2 mm for load bearing & non-load bearing structures |
| 3.9.5 | Feeder details | Incomer – 2nos.<br>Outgoing – 12nos. |
| 3.10 | **UPS ACDB for 10KVA UPS** | Applicable |
| 3.10.1 | Quantity | 1no. |
| 3.10.2 | Voltage | 230V,AC |
| 3.10.3 | IP | 42 |
| 3.10.4 | Sheet Steel thickness | Min. 2 mm for load bearing & non-load bearing structures |
| 3.10.5 | Feeder details | Incomer – 2nos.<br>Outgoing – 12nos. |

Ref. Doc

## PART-5 (BIDDERS TECHNICAL DATA)

Following technical data has to be furnished by B idder.

| Sr No. | DESCRIPTION | BIDDER'S DATA |
|---|---|---|
| 1.0. | **UPS SYSTEM** | |
| 1.1. | Make | |
| 1.2. | Type designation | |
| 1.3. | Rating (KVA at rated p.f.) | |
| 1.4. | Input p.f | |
| 1.5. | Output P.f | |
| 1.6. | Mode of operation | |
| 1.7. | Dynamic Response under following co nditions | |
| a) | For 50% step load | |
| b) | For 100% step load and unload | |
| c) | Power supply interruption and restoration | |
| d) | Load Transferred to bypass line | |
| e) | When one inverter gets faulty and load is transferred to healthy inverter | |
| 1.8. | Maximum recovery time to reach steady state after above disturbance | |
| 1.9. | Type of cooling & Redundancy in cooling system | |
| 1.10. | Degree of ingress protection of panels | |
| 1.11. | Noise level | |
| 1.12. | Color shade | |
| 1.13. | Efficiency of bypass stabilizer including input transformer | |
| a) | At 100% load | |
| b) | At 75% load | |
| c) | At 50% load | |
| d) | At no load | |
| 1.14. | Overall efficiency of UPS system (ratio of output load to input power drawn from mains when all charger and inverters are on and Synchronized with bypass operating at no load) | |
| a) | At 100% load | |
| b) | At 75% load | |
| c) | At 50% load | |
| d) | At no load | |
| 1.15. | Cable entry | |
| 1.16. | Guaranteed dimensions (LXDXH) of UPS system except Battery | |
| 1.17. | Heat loss for the total system (KW) | |
| 2.0. | **INVERTER** | |
| 2.1. | Rating (at specified ambient)/No. of phases | |

| | | |
|---|---|---|
| 2.2. | DC Input voltage (Nominal/Range) | |
| 2.3. | DC Input Current | |
| a) | No Load | |
| b) | Full Load | |
| 2.4. | Steady state output frequency(Nominal/Variation) | |
| 2.0. | Steady state output voltage (Nominal/Variation) | |
| 2.1. | Output voltage adjustment range at rated load | |
| 2.2. | A.C. Output Current at No Load | |
| 2.3. | A.C. Output Current at Full Load | |
| 2.4. | Maximum Inrush current during inverter energisation | |
| 2.5. | Frequency variation limit for inverter phase locked with mains | |
| 2.6. | Allowable unbalance between phases (for 3 phase only) | |
| 2.7. | Harmonic distortion at inverter output at rated load | |
| a) | For linear load | |
| b) | For nonlinear load | |
| 2.8. | Overloading capacity and duration | |
| 2.9. | Short circuit capacity and duration | |
| 2.10. | Output voltage and phase angles (for 3-Ph only) | |
| a) | For 30% unbalance load | |
| b) | For 40% unbalance load | |
| c) | For 50% unbalance load | |
| d) | For 100% unbalance load | |
| 2.11. | Type of control circuit | |
| 2.12. | Load crest factor (for which UPS is designed) | |
| 2.13. | Max. allowed rating of outgoing feeders for fault clearance of feeder fault by UPS with and without mains bypass supply back up (as percentage of UPS rating) | |
| a) | With fast acting semiconducting fuses | |
| b) | With normal HRC fuses | |
| 2.14. | Efficiency of each inverter module including input and output transformer | |
| a) | At 100% load | |
| b) | At 75% load | |
| c) | At 50% load | |
| d) | At no load | |
| 2.15. | SCR Element provided with | |
| a) | Surge protection | |
| b) | Fast acting HRC Fuse | |
| 2.16. | Cooling | |
| a) | Type | |
| b) | No. of fans | |

| | | |
|---|---|---|
| c) | Operating time at full load without forced air coo ling (if applicable) | |
| 3.0. | **STATIC SWITCHES** | |
| 3.1. | No. of static switches in each UPS system | |
| 3.2. | Current rating at specified ambient (continuous / s hort time) | |
| 3.3. | Slew Rate | |
| 3.4. | Type of static switch | |
| 3.5. | Transfer time | |
| a) | Synchronized mode | |
| b) | Unsynchronized mode | |
| 4.0. | **RECTIFER/CHARGER** | |
| 4.1. | Current Rating | |
| 4.2. | Type of Charger | |
| 4.3. | Input amps at the following loads in addition to th e battery charging current supply | |
| a) | 50% rated load | |
| b) | 100% rated load | |
| c) | 110% rated load | |
| 4.4. | Charger Maximum Inrush Current | |
| 4.5. | Output voltage under | |
| a) | Float charging | |
| b) | Rapid charging | |
| 4.6. | Output Voltage accuracy under specified input | |
| 4.7. | Maximum ripple content on DC side with | |
| a) | Battery connected | |
| b) | Battery disconnected | |
| 4.8. | Maximum harmonic content in input current | |
| 4.9. | Input transformer rating | |
| 4.10. | Efficiency of each charger module including input a nd output transformer | |
| a) | At 100% load | |
| b) | At 75% load | |
| c) | At 50% load | |
| d) | At no load | |
| 4.11. | SCR Element provided with | |
| c) | Surge protection | |
| d) | Fast acting HRC Fuse | |
| 4.12. | Cooling | |
| d) | Type | |
| e) | No. of fans | |

| | | | |
|---|---|---|---|
| f) | Operating time at full load without forced air coo ling (if applicable) | | |
| 5.0. | **MANUAL TRANSFER DEVICE** | | |
| 5.1. | Total No. of switches | | |
| 5.2. | Make/Type designation | | |
| 5.3. | Rated Voltage | | |
| 5.4. | Rated Current | | |
| 5.5. | Short time Current rating | | |
| 5.6. | No. of Positions for each switch & Details of posit ions | | |
| 6.0. | **BATTERY** | | |
| 6.1. | Make | | |
| 6.2. | Type designation | | |
| 6.3. | Type | | |
| 6.4. | AH rating of each battery | | |
| 6.5. | End cell voltage | | |
| 6.6. | Nominal voltage of each battery | | |
| 6.7. | No. of cells in each bank | | |
| 6.8. | Overall Dimension of each cell | | |
| 6.9. | Weight of complete cell: | | |
| a) | Without Acid | | |
| b) | With Acid | | |
| 6.10. | Material of inter-cell connector | | |
| 6.11. | Type of separator | | |
| a) | Type | | |
| b) | Material | | |
| c) | Thickness | | |
| 6.12. | No. of battery banks | | |
| 6.13. | Battery charging requirements | Volt/cell | Current |
| a) | Nominal | | |
| b) | Float | | |
| c) | Rapid charging | | |
| d) | Equalizing charge | | |
| 6.14. | Rapid charging time | | |
| 6.15. | Recommended Specific gravity at 27°C | | |
| a) | For first filling | | |
| b) | At full charge | | |
| c) | At the end of 10 hour discharge | | |
| 6.16. | Type of Racks i.e no. of racks and tiers with clearances | | |
| 6.17. | Overall rack dimensions | | |
| 6.18. | Material of Rack | | |
| 6.19. | Container type | | |
| 6.20. | No. of recommended air changes/hour for battery room | | |
| 6.21. | Expected Life of battery | | |
| 6.22. | Battery internal resistance | | |
| 6.23. | Overall Dimension | | |
| 6.24. | Overall Weight | | |

| | | |
|---|---|---|
| 7.0. | **STEP DOWN BYPASS TRANSFORMER WITH SOLID STATE VOLTAGE STABILIZER** | |
| 7.1. | Make/Type designation | |
| 7.2. | Rating and voltage ratio | |
| 7.3. | Accuracy of Stabilizer | |
| 7.4. | Type of Control | |
| 7.5. | Type of Cooling | |
| 7.6. | Type of Stabilizer | |
| 7.7. | Class of insulation | |
| 7.8. | Guaranteed loss at 100% rated voltage and rated frequency | |
| 7.9. | No Load loss | |
| 7.10. | Copper loss at full load | |
| 7.11. | Efficiency at 0.8 p.f | |
| a) | At full load | |
| b) | At 1/2th load | |
| 8.0. | **ISOLATION TRANSFORMERS** | |
| 8.1. | Make /Type designation | |
| 8.2. | Rating and voltage ratio of input transformer | |
| 8.3. | Rating and voltage ratio of output transformer | |
| 8.4. | Type of Cooling | |
| 9.0. | **VARIABLE RESISTOR BANK** | **Not Applicable** |
| 9.1. | Make/ Type designation | |
| 9.2. | Voltage range | |
| 9.3. | Current range | |
| 10.0. | **RELIABILITY** | |
| 10.1. | Safety factor used for selecting the components | |
| a) | Electronic devices | |
| b) | Electrical devices | |
| 10.2. | MTBF/MTTR | |
| 10.3. | Availability factor | |

Ref. Doc

## PART-6 (PRICE SCHEDULE)

| Sl. no | Description | Unit | Qty | Unit Price | Total Value | Remarks |
|---|---|---|---|---|---|---|
| **I** | **Main Equipment** | | | | | |
| 1 | Complete UPS System package of 5 kVA with ACDB & 1x100% VRLA battery & its associated items as specified in the technical enquiry & Annexure A | sets | 11 | | | Refer Note – i,j below |
| | a) 5 KVA UPS leg<br>b) Bypass Servo Controller<br>c) Battery bank including accessories<br>d) UPS ACDB | Set<br>Set<br>Set<br>Set | 11<br>11<br>11<br>11 | | | Price Break for I(1) |
| 2 | Complete UPS System package of 10 kVA Parallel redundant UPS with ACDB & 2x100% VRLA battery & its associated items as specified in the technical enquiry & Annexure A | Set | 2 | | | Refer Note – i,j below |
| | a) 10 KVA UPS leg<br>b) Bypass Servo Controller<br>c) Battery bank including accessories<br>d) UPS ACDB | Set<br>Set<br>Set<br>Set | 4<br>2<br>4<br>2 | | | Price Break for I(2) |
| 3 | **Mandatory Spares** | Ref Note- k below | | | | |
| 3.1 | 5KVA_MCCB's, MCB's of each type | Set | 1 | | | 1Set = 1no. of each type & rating for 11 no. of 5 KVA UPS |
| 3.2 | 5KVA_A.C fuse of each type | Set | 1 | | | 1Set = 10% of total installed capacity for 11 no. of 5 KVA UPS |
| 3.3 | 5KVA_D.C fuse of each type | Set | 1 | | | |
| 3.4 | 5KVA_Push Button and Switches | Set | 1 | | | |
| 3.5 | 5KVA_Terminal Block | Set | 1 | | | |
| 3.6 | 10KVA_MCCB's, MCB's of each type | Set | 1 | | | 1Set = 1no. of each type & rating for 2 no. of 10 KVA UPS |
| 3.7 | 10KVA_A.C fuse of each type | Set | 1 | | | 1Set = 10% of total installed capacity for 2 no. of 10 KVA UPS |
| 3.8 | 10KVA_D.C fuse of each type | Set | 1 | | | |
| 3.9 | 10KVA_Push Button and Switches | Set | 1 | | | |
| 3.10 | 10KVA_Terminal Block | Set | 1 | | | |
| **II** | **Services for above main equipment** | | | | | |
| 1 | Lump sum Price for supervision of E&C of I(1) above | Set | 1 | | | 1Set = 4 Visits & Ref note- c, d,g below |
| 2 | Lump sum Price for supervision of E&C of I(2) above | Set | 1 | | | 1Set = 1 Visit & Ref note- c, d,g below |
| **III** | **Optional items** | | | | | |
| 1 | Price for recommended spares for 5 years operation with BOM | | | | | Refer Note – e,f,g below |

| | | | | |
|---|---|---|---|---|
| 2 | Per Man-day charges for additional stay/additional visit inclusive of travel expense | | | Refer Note –e, g below |

**Notes:**

a. Vendor shall **strictly** submit the prices in the above format only. Prices quoted in any other format shall not be considered for evaluation.

b. Vendor shall also furnish original unpriced price format along with technical bid duly signed by vendor. In un-price schedule "**Quoted**" to be mentioned where ever (unit & total prices columns) price quoted in original price offer.

c. Lump sum prices for Supervision of Installation & commissioning of Equipment at site (i.e. II (1)) shall include Travel expenses, Incidental charges, Man-day charges and any other charges if applicable.

d. Commissioning of Project will take place in multiple spells in line with Power Collection Sub Station (PCSS) wise commissioning schedule. Vendor shall quote in lump sum for **5KVA UPS - four visits (minimum period of 4 days per visit)** & **10KVA UPS – One visit (minimum period of 4 days per visit)** for their visits to site. For realization of payment vendor needs to submit job completion report/certificate issued by BHEL site office. During the Guarantee Period, if any trouble shooting or re-work is needed, the vendor is to provide the necessary assistance within the quoted rates.

e. Vendor to quote prices for the optional items at Sl. Nos. III (1) & III (2) above along with the main equipment. BHEL reserves the right to order along with main equipment or separately or not at all.

f. For Sl.No. III (1) of above, bidder to provide list of 5years recommended O&M spares along with unit price of each item. BHEL reserves the right to order full/partial quantity of the 5 years recommended O&M spares along with the main equipment or separately or not at all. The bidder will keep their prices valid till execution of order or till 18 months from the date of P.O, whichever is later.

g. No. of days and payment on account for additional visits for II (1&2), III (2) of above shall be released based on BHEL site certification.

h. Lowest Bidder (L1) evaluation shall be done by considering the sum of prices quoted at Sl.no **I(1), I(2),I(3) & II(1&2)** of above Price schedule only.

i. Validity of all the above prices shall be kept **firm** till successful handing over of the equipment to end user.

j. Prices of I (1 &2) above shall be inclusive of Start-up & Commissioning spares as applicable.

k. Vendor to refer **part-3 for exact quantity of mandatory spares**. Vendor to quote price for I (3) above accordingly.

**(Signature of the Vendor)**

# QAP GUIDELINES & FORMAT

`

( ANNEXURE - TO PY55207_Rev01)

The QAP format and guidelines for filling up the format shall be used by vendor for preparation and submission of QAP after order placement.

**Note :**

1. Typical /Indicative /Standard QAP(s) for equipment /package attached is reference document and to use by successful bidder in future for preparation and submission of QAP for BHEL /CUSTOMER approval.

2. No deviation to reference document is acceptable.

Ref. Doc

## GUIDELINES TO VENDORS FOR PREPARATION OF QUALITY ASSURANCE PLAN

1. QAP shall be made in landscape mode on A4 size paper as per the format enclosed. Font size shall be minimum 10.

2. Each page of QAP shall contain the following information.
   a) Vendor's name & address.
   b) Customer: BHEL, Hyderabad.
   c) Project.
   d) BHEL Product Standard Number/revision number as referred in P.O.
   e) BHEL Purchase Order Number & Date.
   f) Product as per P.O. description.
   g) QAP Number (unique and shall not repeat)/revision number/date.
   h) Page number and number of pages

3. QAP shall contain four parts / stages as follows.
   a) Raw materials and bought out items.
   b) In process Control / Inspection.
   c) Final assembly, Inspection & Testing.
   d) Painting, preservation & packing.

4. Under 'Component', indicate name of the component (say casing, rotor, pressure gauge, etc).

5. Under 'Characteristics', indicate appropriately (say chemical analysis, mechanical properties, NDT (UT,DP etc.), hydrostatic test, calibration check etc.)

6. Under 'Class', indicate minor, major or critical depending on the importance of characteristic.

7. Under 'Type of check', indicate appropriately (say chemical, mechanical, UT, DP etc.)

8. Under 'Quantum of check', indicate appropriately (say 100%, 10%, sample, per melt, per heat, all pieces etc.)

9. Under 'Reference document' and 'Acceptance norms', appropriate National & International standards, BHEL standards, approved drawing references etc. should be indicated. It is not correct to mention as "Vendor's internal standards or Vendor's standard practice etc.". If vendors' internal standards are referred, same shall be in line with BHEL Spec. indicated in the P.O. These may require review & approval by our Engineering dept.

10. Under 'Format of record', indicate appropriately supplier's test certificate, calibration certificate, lab report, inspection report etc.

11. Please refer 'Agency' in QAP format.
    Under P: Perform, W: Witness, V: Verify
    Indicate against each characteristic 1: (BHEL CQS/Nominated inspection agency), OR
    2: (Vendor / Sub vendor)

Note: Performing agency is normally vendor or his sub vendor (Legend 2). Where witness points are indicated in specification, P.O., Drawing etc., for such operations, under Witness (W) column use 1. Under 'Verify' column, use code1.

12. Under 'D' please put (□ Tick) against each characteristic where vendor proposes to submit test certificate/report etc. OR as required as per BHEL Specification.

13. Vendor's signature & stamp should be available on each page of QAP.

14. Vendor should read the BHEL Product Standard thoroughly and QAP should be made only inline and relevant to the Specification & Approved Drawings.

15. The following operations/characteristics/check points may be included (AS APPROPRIATE)
    a) Visual check
    b) Dimensional check
    c) Mechanical and Chemical properties.
    d) Surface preparation before painting (by chemical cleaning, sand blasting, shot blasting etc. as the case may be.)
    e) Painting check for shade, Dry Film Thickness (DFT), Adhesion/ peel off test etc.
    f) Check for correctness for all components mounted as per General arrangement Drawing, Bill Of Materials (BOM), etc. for range, rating, make, color, size, location as per GA, quantity, label description including tag nos., annunciator facia, loose components, accessories, spares etc.
    g) Verification of test certificate for protection class for the enclosures.
    h) Mechanical functioning of switches.
    i) Continuity of earthing and provision of earth points.
    j) Colour coding of wiring, size, tightness & dressing of wiring.
    k) Review of test certificates of assembled items, raw materials, internal test reports etc.
    l) Witness of functional checks, which may include mechanical run & electrical run, H.V.test, IR measurement, Electrical and Mechanical tests etc.
    m) PQR, WPS, Welder Qualification Record, welding records (fit up, DP) etc.
    n) Material identification ( for punch marks of serial numbers, Heat No, Melt No, Inspector's stamp etc.)
    o) Hydraulic Pressure Test, Pneumatic Pressure Test, Liquid Penetration Examination and other Non Destructive Tests.
    p) Tests on Galvanised items (Visual, Hammer Test, Knife Test, Thickness, Pierce Test (Copper sulphate test), Hydrogen evaluation test, Stripping test (for Mass of Zinc coating)
    q) All tests as per BHEL Product Standard & approved drawings including Type tests and Routine tests on individual items and on System as a whole.
    r) Packing and Preservation.

16. **QAP Format enclosed.**

**17. Typical Manufacturing QAP is attached.**

| VENDOR'S NAME & ADDRESS: | **MANUFACTURING QUALITY PLAN** | | QP. NO.: | |
|---|---|---|---|---|
| | CUSTOMER: BHEL, HYDERABAD – 32.<br>PROJECT:<br>PRODUCT: | BHEL P.O.NO.:<br>P.O.DATE:<br>BHEL SPEC: REV: | REV NO: | DATE: |
| | | | PAGE 1 OF 1 | |

| SL NO | COMPONENTS | CHARACTERISTICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | * D | AGENCY P | AGENCY W | AGENCY V | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.0** | **RAW MATERIALS & BOUGHT OUT ITEMS** | | | | | | | | | | | | |
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| **2.0** | **INPROCESS INSPECTION** | | | | | | | | | | | | |
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| **3.0** | **FINAL INSPECTION & TESTING** | | | | | | | | | | | | |
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| **4.0** | **PRESERVATION & PACKING** | | | | | | | | | | | | |
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**VENDOR TO NOTE**: THIS FORMAT IS IN MICROSOFT WORD. HEADER & FOOTER SHALL BE AVAILABLE IN EACH PAGE OF QP. QP SHALL BE IN LANDSCAPE & A4 SIZE ONLY. FONT SIZE SHALL BE MIN 10. VENDOR SHALL SIGN & STAMP IN EACH PAGE OF QP. LOI REF. & DATE ARE NOT ACCEPTABLE. P.O.NO. & DATE SHALL BE INDICATED. QP NO. SHOULD BE UNIQUE AND SHALL NOT REPEAT. ALL THE TESTS / CHECKS INDICATED IN THE BHEL SPEC. SHALL BE INDICATED IN THE QP.

| LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS. | PREPARED BY<br><br>VENDOR'S SIGNATURE & STAMP | APPROVED BY<br><br>BHEL QA SIGNATURE & STAMP | APPROVED BY<br><br>CUSTOMER'S SIGNATURE & STAMP |
|---|---|---|---|

| VENDOR'S NAME & ADDRESS: | **TYPICAL QUALITY PLAN** | | QP. NO.: | |
|---|---|---|---|---|
| | CUSTOMER: BHEL, HYDERABAD – 32.<br>PROJECT:<br>PRODUCT: UPS SYSTEM | BHEL P.O.NO.:<br>P.O.DATE:<br>BHEL SPEC: REV: | REV NO: | DATE: |
| | | | PAGE 1 OF 10 | |

| SL NO | COMPONENTS | CHARACTERISTICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | * D | AGENCY P | AGENCY W | AGENCY V | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.0** | **RAW MATERIALS & BOUGHT OUT ITEMS** | | | | | | | | | | | | |
| 1.1 | Magnetics ( Power & Control Transformer ) | Dimension, HV, HVHF | MA | Visual, Testing | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Supplier Report | √ | 2 | | 1 | |
| 1.2 | Enclosures | Dimension, Coating Thickness | MA | Visual, Measure ment | 1 / batch | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 1.3 | Fabricated & Punched Items | Dimension, Punching | MA | Visual | 1 / batch | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 1.4 | Heat sinks | Dimension, Surface Finishing, Mounting holes | MA | Visual, Measure ment | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 1.5 | Rubber items (Gaskets & Grommets) | Dimension, Finish | MA | Visual, Measure ment | Sample | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 1.6 | Bus bars & Hardware | Dimension, Finish, Threads | MA | Visual, Measure ment | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 1.7 | Acrylic Material | Dimension, Finish | MA | Visual, Measure ment | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |

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|---|---|---|---|---|
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| | | | PAGE 2 OF 10 | |

| SL NO | COMPONENTS | CHARACTERISTICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | * D | AGENCY P | AGENCY W | AGENCY V | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.8 | Current Transformers | O/P Accuracy | CR | Visual, Measure ment | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 1.9 | Switchgears | Physical, NO/NC, Auxiliary Contacts | CR | Visual, Measure ment | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 1.10 | Fuses & Fuse Holders | Physical, Continuity, Type | MA | Visual, Measure ment | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 1.11 | Capacitors | Physical, Capacitance, Type & routine test | CR | Visual, Measure ment | 100% or Sample | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 1.12 | Semiconductor Device | Physical | CR | Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Supplier Report | √ | 2 | | 1 | |
| 1.13 | Voltage Regulating Devices (SCVS, SSVS) | Physical, HV, IR, No Load Regulation, Type & Routine test | CR | Visual, Measure ment | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 1.14 | Wires, Cables & Cable Glands | Physical, HV, Type | MA | Visual, Measure ment | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Supplier Report | √ | 2 | | 1 | |

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| | | | PAGE 3 OF 10 | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.15 | Batteries | Physical | CR | Visual, OCV | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Supplier Report | √ | 2 | | 1 | |
| 1.16 | Fans | Smooth running, Physical | MA | Visual, Electrical | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 1.17 | Indicating Devices ( Lamps, LEDs etc. ) | Physical & Test | MA | Visual, Measure ment | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 1.18 | Meters | Physical, Accuracy, Rating , Type | MA | Visual, Measure ment | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 1.19 | Packing Material ( Wood, Thermocol ) | Physical, Type of material | MA | Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 1.20 | ***PCBs*** | Material, PTHs, Tracks, Surface Level | MA | Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| | ***PCB Manufacturing & Testing*** | | | | | | | | | | | | |
| 1 | PC Assembly Room ( including storage facility ) | Physical, ESD Measures | MA | Visual, Testing | Every 6 months | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | | 2 | | 1 | |

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| | | | PAGE 4 OF 10 | |

| SL NO | COMPONENTS | CHARACTERISTICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | * D | AGENCY P | AGENCY W | AGENCY V | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | Stuffing | Mounting | CR | Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | | 2 | | 1 | |
| 3 | Soldering (Wave & Manual Soldering ) | Dry Solder, Solder Joints | CR | Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | | 2 | | 1 | |
| 4 | Inspection | Cleaning, Short Links | CR | Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 5 | Testing | Functional, Burn-in | CR | Electrical | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1 | |
| 6 | Anabond & Conformal Coating (CRC) | Physical | CR | Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | | 2 | | 1 | |
| **2.0** | **INPROCESS INSPECTION** | | | | | | | | | | | | |
| 1 | Company's Logo | Position | MI | Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | | | 2 | | 1 | |
| 2 | Rating Plate | Serial #, System Details | MI | Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | | | 2 | | 1 | |

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| | | | PAGE 5 OF 10 | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | BOMs, Drawings : Product consistency | Matching, Availability, Layout | CR | Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | | | 2 | | 1 | |
| 4 | Fitting | Mounting, Tightening | CR | Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | | | 2 | | 1 | |
| 5 | Lugging & Crimping | size, firm joint | CR | Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | | | 2 | | 1 | |
| 6 | Cabling & Wiring | Routing, Finishing, Tying, Ferruling, Color Coding | CR | Visual & Continuity | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | | | 2 | | 1 | |
| 7 | Painting & Finishing | Uniform Coating thickness, Paint Shade | CR | Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | | | 2 | | 1 | |
| 8 | Doors, Locks & Hinges | Smooth & Proper Working | MI | Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | | | 2 | | 1 | |
| 9 | Clearance & Creepage | Dimension | CR | Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | | | 2 | | 1 | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | IR Test (after+ before HV) | Insulation Resistance | CR | Measure ment | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | | | 2 | | 1 | |
| 11 | HV Test | Dielectric Breakage | CR | Measure ment | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | | | 2 | | 1 | |
| | | | | | | | | | | | | | |
| **3.0** | **FINAL INSPECTION & TESTING** | | | | | | | | | | | | |
| **3.1** | **Functional & Performance test** | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | IR & HV Test , Checking of Aux Devices ,O/P volt. tolerance, O/P freq. tolerance(Variation),P F at rated load at 50%,75%,100%,IP Test, Heat-Run at full load, Temperature rise test, Over voltage capability test, Load regulation test, Restart test, AC input failure test, AC input return test, Parameters Setting, Light Load Test, Transfer-retransfer test, Burn-in, Regulation, Efficiency, Noise Figure, Load Sharing, Auxiliary Modules, Distribution Modules, BOM Verification | CR | Electrical & Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | 1/3 | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | visual check for dimension, paint shade, component verification ,Internal tc review of components, Burn in test for PCB for 96 hours at 50 degree(only review), Simulation of parallel redundant UPS fault, Overall efficiency ,Current division in parallel ,Synchronization test, Short ckt test on fuse ,O/p over volt test ,Over voltage protection test, Overload capability test, Earth fault test, Auto transfer to bypass/isolation mode & back to normal , Manual transfer to bypass/isolation mode & back to normal, Parallel redundant UPS fault, Transfer test to bypass, Input frequency tolerance, Input inrush current, Input pf measurement, | CR | Electrical & Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | 1/3 | | |

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| SL NO | COMPONENTS | CHARACTERISTICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | * D | AGENCY P | AGENCY W | AGENCY V | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dynamic performance-Step Load normal mode, Acoustic Noise | CR | Electrical & Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | | √ | 2 | 1/3 | | |
| 3.2 | Routine test | | | | | | | | | | | | |
| | Routine test | Insulation test as per IEC 60146-1-1, Interconnection cable checks, No load test, Checking of auxiliary devices, Output voltage tolerance, Temperature Rise Test, Output frequency tolerance, Efficiency checks at rated p.f. for 50%, 75% & 100% load | CR | Electrical & Visual | 100% | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Test Report | √ | 2 | | 1/3 | |
| 3.3 | **All type test shall be as per BHEL approved drawing /data sheet & Specification** | | | | | | | | √ | | | 1/3 | |
| **4.0** | **PRESERVATION & PACKING** | | | | | | | | | | | | |
| | | PACKING* | MAJOR | VISUAL | RANDOM | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | AS PER BHEL SPEC/APPD Drg/APPD DATASHEET | Packing List | √ | 2 | | 1 | *Packing for export orders shall be seaworthy (i.e. as per HY0490573) |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

**VENDOR TO NOTE**: THIS FORMAT IS IN MICROSOFT WORD. HEADER & FOOTER SHALL BE AVAILABLE IN EACH PAGE OF QP. QP SHALL BE IN LANDSCAPE & A4 SIZE ONLY. FONT SIZE SHALL BE MIN 10. VENDOR SHALL SIGN & STAMP IN EACH PAGE OF QP. LOI REF. & DATE ARE NOT

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |

ACCEPTABLE. P.O.NO. & DATE SHALL BE INDICATED. QP NO. SHOULD BE UNIQUE AND SHALL NOT REPEAT. ALL THE TESTS / CHECKS INDICATED IN THE BHEL SPEC. SHALL BE INDICATED IN THE QP.

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